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INTERNAL IMPROVEMENT.

Rail Roads, Canals, Bridges, &c.

The subject of internal improvement having attracted the attention of our citizens, the following remarks, several of which are the result of personal observation, during a tour in Europe, contain some hints which may not be altogether uninteresting.

The great object of roads, canals, railways, bridges, steam and other engines, is to transport a given weight, or to produce a given effect, with the least quantum of labour, and with 1. *Expedition,* 2. *Certainty, and* 3. *Safety.*

In the following essay it is intended to inquire to what extent these objects are attained by these several inventions, previously submitting the following observations. In these labour saving machines, if more labour (or what is equivalent, money,) is expended in their erection, than can be saved by their assistance, the sound dictates of political economy would forbid their adoption; this inference may appear a truism to many, but has been so frequently neglected in practice, to the great detriment of commonwealths, that it cannot too frequently be presented to our view, the neglect of it having occasioned losses of enormous magnitude to individuals, who have embarked their capital in these enterprises from motives of patriotism or interest, without due consideration of the causes which alone could produce the result they anticipated. Capital, which otherwise would have been employed in agriculture, commerce or manufactures, and have produced the usual returns of interest, has been squandered in schemes, which the projectors wildly imagined to be improvements, which have not enriched the public, whilst they made them poor indeed. In these instances, individual losses are national

impoverishment. It is not intended to assert that the production of the average rate of interest of any country is the exclusive test of the utility of works constructed for the public accommodation.

For instance, the celebrated canal du Midi, usually known as the Languedoc canal, which has been the subject so frequently of injudicious eulogy, is an instance of this misapplication of national enterprise; no toll is at present levied on the boats traversing its surface; but the amount of commerce is so small that it is acknowledged that two per cent. per annum on the principal expended could not possibly be collected, if it were attempted. This work, however, has *indirectly* been very beneficial, as it induced engineers to turn their attention to the subject of canals, and although not the first executed, may be justly styled the mother of inland navigation.

2d. Where works are executed at the expense of the government, although no tolls be collected, (which is the case generally on the *continent* of Europe,) notwithstanding the nation may be benefited by their operation, if firstly the commerce, which is transacted by their assistance, be sufficiently extensive to enable the government, if deemed expedient, to levy tolls, to receive an amount equivalent to the interest of the capital expended in their execution and annual repairs, although no tolls be collected, in fact, if the capacity of yielding them be established, by any evidence, the effect is beneficial. The state will, in this case, be benefited by the additional wealth of her inhabitants, and the increase of her population, the certain consequence of the facility of maintenance, produced by this easy access to market; thereby affording to government additional objects suitable for taxation.

Or, 3d. When tolls are levied, and are for a few years after the execution of the work deficient, *if afterwards they amount to interest on the deficiency and capital united.* In the event of war, the transport of munitions may be sufficient to justify the execution of works which would perhaps be useless to a considerable degree in peace. The policy of constructing will, in this case, depend on the comparative duration of war and peace; as a sudden invasion may require the forwarding troops and supplies with expedition and economy of labour; in accomplishing this object, the benefits of which are beyond calculation, roads, bridges, canals and railways, from the remarkable facility they afford to transportation, may then prove the salvation of a country.

Our last war with England afforded melancholy demonstration of the force of this argument.*

Having premised these observations which are applicable to every species of public works, it is intended to inquire the extent to which 1st roads, 2d canals, and 3d rail roads are severally conducive to these objects. In this place we must repeat the demonstrable law of motion, "*that any given weight, however great, may be transported to any given station, by any power, however trifling, provided the line of motion be horizontal, and friction and the resistance of the atmosphere be removed.*" This, it is obvious, can never be attained in practice, the most simple and perfect machinery can overcome a portion only of the obstacles by which motion is impeded. Various methods have been attempted to partially accomplish this object. Roads are the most ancient and obvious improvements in the art of transportation; which was previously effected by dragging the weight, unassisted by wheel carriages, over the natural surface of the country, abounding with rocks, swamps, trees and other obstacles. In some countries, where civilization has made little progress, this tedious and laborious method prevails at the present hour. Sometimes the weight is placed on the backs of men or other animals; this prevails in Spain and the late Spanish colonies generally. The prodigious advantage resulting from science may be appreciated by reflecting that a weight, which, on an improved rail road, could be transported with facility by the agency of a single horse, would, among our red brethren, require the laborious application of a 1000 squaw power to remove.

Wheel carriages were in due time invented; on a common road, or even turnpike, they encounter numerous obstacles: 1st, if the soil be soft, (which is always the case to a certain extent, particularly in moist weather, or in sandy districts,) it accumulates in front of the wheels, and *however level the general surface of the road may appear, the carriage wheels are perpetually toiling up hill.* 2d, deep ruts occasion so much friction, that the progress of the carriage is always impeded, and sometimes entirely stopped, and only extricated by the application of very great force. To these may be added, 3d, impediments from stones and other opposing bodies, and 4th, frequent hills of great elevation.

Turnpikes are the next improvements. As they are usually executed in the United States, the impediments are nu-

* See the report of Mr. Gallatin to congress on this subject.

merous and powerful—composed of very large masses of rock at the foundation, and small stones with soil at the top, which, invariably sinking to the bottom expose, the rugged surface of the foundation covered with mire.

These and other obstacles prevail almost invariably on the turnpikes in the United States. The superiority of the turnpikes in England, constructed in many instances on the principles of M'Adams, is apparent to every observer. They are entirely composed of very small angular and equal pieces of rock, a heavy roller passed over the surface, and the motion of carriages soon occasions a consolidation; as no earth is used, rain occasions but little mud on this hard, solid and smooth surface—the phenomenon of a carriage disappearing in the mire, of course, occurs rarely! The route usually winds around the bases of the high hills, in place of adhering to the absurd and unpicturesque mathematical straight line, so much admired in the United States, under the erroneous idea of saving distance, and consequently labour. If, for instance, the distance in a straight line of two places be five miles, and the hills in the aggregate equal to 1000 feet, it will require the same labour and time to transport a given weight, one ton for instance, as if the road, by winding around the bases of the hills and thereby preserving a level, were increased to double the length, viz. to ten miles. This is demonstrable in the following manner. One horse can draw on a level road on the plan of M'Adams, one ton at the rate of three miles per hour,* whereas his power of draught by the dynamometer ranges only from 80 to 180 pounds; the maximum obtained for a continued length of time from excellent horses, with the foregoing velocity,† assuming the average at 120 pounds, a liberal estimate; a horse can consequently raise by the medium of a pulley or other power where the friction does not exceed twenty pounds—*one hundred pounds perpendicularly at the rate of three miles per hour;* or a horse can raise perpendicularly only one-twentieth of the weight he is capa-

* See M'Adams on Road. See also reports of the Roads Commissioners.

† See description of dynamometer in the Encyclopædia with an account of some experiments performed by the Philadelphia Agricultural Society, in which a much greater power was exerted, for a short time, than the above. Some more definite and precise term is required in mechanics than horse power. This adopted unit of power is very variously estimated by engineers. See the works of Watt, Smeaton, Fulton, Rennie, &c. where it varies more than the power of a London dray horse compared with a Shetland pony.

ble of drawing horizontally, with the same velocity, on a turnpike.

Even the distance is frequently not diminished; in some steep hills a line over the summit, or on a level around the base, is of similar length; this occurs in a hill of one hundred feet elevation, and a road over its summit, one thousand feet in length; if the remaining sides be abrupt, a road may be sometimes conducted around the base of the same length; a weight could be drawn on the latter in half the time, or with half the labour it would require on the former;—or if the level road should require double the distance, the weight would require only the same moving power. The delay always occasioned by hills has given rise to the proverb, "the longest way about is the shortest way home." By the absurd practices alluded to, even ground is not saved; for the extra labour expended in toiling to the summit of these hills, requires an additional number of horses to be maintained for this purpose; the ground requisite for their support is incalculably more than the trifle saved by the shortness of the road. An apparent exception to the policy here recommended must now be mentioned. Several persons accustomed to travelling have observed, that when a horse has for a long time drawn on a perfect level, if a very slight ascent and descent occurs, he appears to be refreshed; the reason assigned is, that another set of muscles are called into action, allowing those fatigued some repose: some difference of opinion, however, prevails on this subject.*

Having now considered the benefits resulting from roads; it is proposed to institute a comparison with canals, in reference to the objects stated in the commencement of this essay.

1st. The expense of constructing a turnpike *in a proper manner*, is *almost equal* to that usually expended per mile on a canal. Part of the National or Cumberland Road cost 17,000 dollars per mile; and part of the Lancaster turnpike near Philadelphia, 15,000 dollars per mile: these roads, if *M'Adamised*, would have cost more in the

* The law of gravitation, viz; that the power required in ascending, is gained in descending, is not applicable to roads, for obvious reasons; the surface of the road when hilly, is uneven and rough, this is occasioned by the rains and the methods resorted to, to protect them; the great fatigue experienced by the horses prevents them from exerting their full power when they arrive on a level: in descending, great power is required to prevent too rapid a motion, and the wheels are frequently locked; in this manner, the advantage in descending by no means ballances the disadvantages in ascending, &c. many other reasons might be offered; these remarks do not apply to railways.

first instance; the repairs would require less. These depend, in a great measure, on the use to which the road is devoted, and the frequency of the same. In some roads in the United States, the expense is equal to interest on the principal of the expenditure. Near London, in consequence of the frequency of travelling, 1000 pounds sterling is annually required to preserve the great road in repair.* The repairs of canals, when *correctly constructed*, are comparatively slight; the difference which of course should be added to those expended on roads, will exhibit the relative expense of both to the public.

It has been frequently proved by writers on inland navigation, (Fulton, Rennie, Phillips, Brindley, Weston, and many others,) that if a given weight be transported by a given power, on a turnpike road, at the rate of two miles an hour, for instance, about twenty times that weight may be moved, with the same velocity, by the same power, on a canal; that is, cæteris paribus, *transportation may be effected on a canal at one-twentieth the expense of the same on roads*; and as it appears that the expense of a good road is equal per mile to a canal, the tolls levied on both may be equal, and the ratio of twenty to one will continue to prevail in favour of canals: but as twenty times the amount may be carried at the same expense on a canal as on a road, the tolls may be reduced to one-twentieth of those demanded on an equally expensive turnpike, and the returns yield an equal interest. On many canals, the tolls charged by the proprietors render conveyance by canals almost equally expensive with road carriage; but as the surplus profit, amounting, in several instances, to the enormous interest of 140 per cent. enriches the stockholders, who are a portion of the public, the benefit to the state depends on the number of proprietors; hence the maximum of benefit occurs when the works are owned by government.

2d. In point of expedition, roads and canals are equal; a load can be transported with the same velocity on either, and for the same length of time. Greater expedition is usually effected on canals, but additional horses are furnished as relays; this of course may be equally effected on roads, as it frequently has been.†

3d. Safety. The wear and tear of merchandize, and the

* See the Reports of the Roads Commissioners.

† On some canals, the horse, when fatigued, is taken on board the boat, from whence one to supply his place is removed: the economy of this expedient may be called in question.

damage from the roughness of roads, and overturning and breaking down of wagons, entitles canals to the preference in this respect. This reason will doubtless influence all travellers who duly regard their comfort, particularly those who have suffered the miseries of that eminently perilous enterprise, a journey to St. Louis or New Orleans.

4th. Certainty. The disadvantages just mentioned, and the frequent unforeseen changes of the weather affecting the roads, always render road conveyance very uncertain.

Having thus briefly exhibited the arguments proving the superiority of canals over the best turnpikes, and à fortiori over those in this country, and over common roads; it is next intended to examine the benefits resulting from rail roads, compared with turnpikes and canals, previously offering a description and historical sketch of the former.

Mankind have long observed the facility with which bodies may be transported on smooth, hard, level surfaces. Ice, combining these properties, is frequently used as an advantageous medium of conveyance. In the removal of excavated earth, a line of boards for the wheelbarrows offers the most simple and primitive form of the rail road, railway, or tram road, as it is variously named, and appears to have been used from a very remote period of antiquity: the obstacles from ruts, stones, and other inequalities, being removed, much is effected by this simple contrivance.

Lord Guilford, in describing the collieries of Newcastle, in the year 1676, mentions the first parallel railway of which any description is on record.* It was entirely composed of wood; viz. large beams, placed parallel at the distance of four feet, which space for the horse path is found to be sufficient. The next improvement consisted in plating the upper surface of these beams with iron, which not only contributed to their preservation, but diminished the friction. The carriage was of enormous size, and contained the whole load: the road to the river Tyne being inclined, a few horses easily dragged it to the place of destination. In the year 1766, the first rails of cast iron were made; the weight was enormous at first, as the load continued to be transported in one carriage; sleepers of wood were placed under the junction of each piece, a flat headed nail being driven flush into an aperture left for that purpose at the end of each rail, secured it in the proper position. A flange cast on each bar prevented the car from deviating from the

* See Stevenson's Essay on Rail Roads.

road, and materially contributed to the strength of the railway; sometimes even an additional flange for the latter purpose was cast on the under surface of the iron, in the form of a segment of a circle, where it could be of no other possible utility. It was soon discovered that it would be more economical to subdivide the load among several cars, attached to each other by chains or ropes, allowing one ton only for each car. In consequence, the rails were reduced in size, preserving the original length of three feet, and four inches width; one inch and a half in thickness was found amply sufficient to resist the diminished pressure; one wheel only of the car now resting on the rail at the same moment, it sustained the slight weight of one-fourth of a ton only. The wheels of the cars encountering no obstacles, (which on common roads render wheels of large diameter necessary,) are from ten to eighteen inches only in height.

The next improvement consisted in substituting small stone piers or props, instead of those wooden supports which were very subject to decay; a hole drilled into the centre of this stone, admitted a wooden plug, into which the nail was driven as before: this pier is always inserted to a depth greater than the penetration of frost.

A very great improvement was effected in the year 1815, by Mr. Jessup, the son-in-law of the celebrated Mr. Smeaton: this renders all treatises on rail roads, prior to this period, of comparatively little value in estimating their use. He increased their utility forty or fifty per cent., by introducing a new form of rail. Rejecting the flat rail of four inches in width, he placed a wrought iron bar, one inch and a half in thickness, edgeways, omitting the flange, for which a substitute was cast on the wheels of the car. The advantage of this alteration was a considerable diminution of friction, from the narrow surface to which the wheels were now applied. The rail was not as liable to break, and from this superior arrangement for strength, a smaller quantity of iron was sufficient. The rails could now be made of great length, thus avoiding the necessity of joints at every pier; a clamped joint, with rivets and washers, was used: this joint will not unscrew, or work loose. Common bar iron, of one inch and a half in thickness, three or four broad, and eight or twelve feet in length, supported every three feet by props, was ascertained to be well adapted for this purpose without alteration. Allowance is always made for the alteration in length produced by the variation of tem-

perature. This road was executed at Tindal Fell, in Cumberland.* The wheels are more subject to wear on this plan than on the flat rail, but do not injure the road to an equal extent: as they are more easily repaired than the rail tracks, this objection has, therefore, little force. On a flat and level railway, the performance of horses varies extremely, ranging from *four to eight tons, at the rate of four miles per hour.* On the edge railway, when level, from *seven to eleven tons* have been drawn with the above velocity. On the level edge road of the Earl of Glasgow, a horse draws ten tons and a half at this rate.† In all these cases, the weight of the cars is included.

The majority of rail roads at present in England and Wales, having been executed prior to the improvement of 1815, are of the flat cast iron species. In Scotland, the reverse prevails.

The dawn of an invention, which promises results far more important and beneficial than any heretofore attempted, first made its appearance near Newcastle, about the year 1798. A high pressure steam-engine, drawing in its train numerous cars, was at that period in successful operation. Others were soon constructed in various parts of England; but for seven-and-twenty years many unsuccessful attempts were made to improve this cumbrous vehicle. Very recently, these efforts have been crowned with the most complete success in Great Britain. This prodigious power can now be obtained in a great measure, divested of its unwieldy gravity, for a very slight expense. The benefit arising from the locomotive engine in England has occasioned the remark, that a rail road without locomotive engines, resembles a canal boat propelled by the agency of oars, unassisted by horses.‡

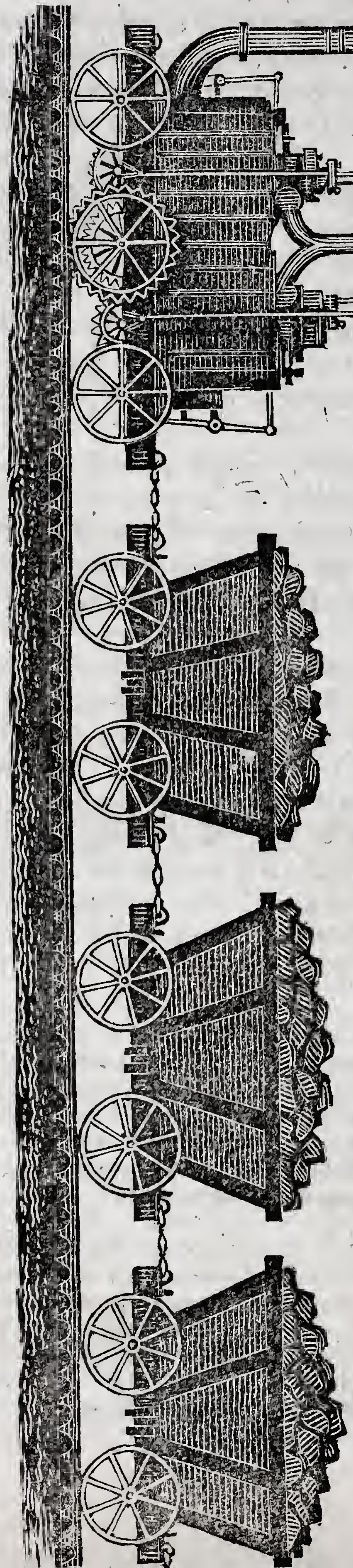
* See Jessup's Essay on Rail Roads.

† This railway, composed of one set of tracks, cost only 660*l*. per mile. See the description by the engineer, in the Supplement to the Edinburgh Encyclopædia. The bars, by an ingenious process, are, (although many feet in length,) wrought into a series of continuous segments of circles: the springing points are at the distance of every three feet, and are supported by piers: an admirable disposition for strength.

‡ The locomotive steam-engine, a rude wood-cut of which is inserted in this essay, reacts by means of the revolving cog-wheel on the protuberances cast for that purpose on the side of one or both of the rails: sometimes a third rail is cast for this purpose. The wheels of the carriage traverse the smooth and parallel rails. The number of cars which the engine is capable of drawing, varies of course with its power. A five horse power can draw fifty of the cars in the plate, of one ton each. As the steam-engine weighs upwards of a ton, the road to sustain it must be stronger, and of course more expensive, than when horse power, or the light gas-engine,

It is confidently expected by many persons, that the Gas

is used. The cog-wheels do not sustain any portion of the weight of the engine.



Vacuum Engine, recently invented by Mr. Browne, will supersede even the steam-engine, particularly on rail roads; the great portability, safety and economy of this engine would seem to authorize this expectation. It is stated that a *six horse power engine*, if supplied with portable gas, will *weigh only one hundred pounds;* and (in England) be maintained at the same expense now required for two horses alone. Sanguine expectations of success are entertained, and the sum of 200,000*l.* vested for the purpose of testing it in practice. Until the result of this experiment be accurately known, any calculations founded on this engine will be, if not visionary, at least premature. *In Great Britain the number of rail roads exceeds canals;* about 107 of the latter are at present finished, and nearly 200 of the former, the aggregate length of which exceeds 1500 miles: and several companies have recently been organized, four of whom alone propose additions, which, when completed will almost equal 2000 miles extra. These speculations have excited great alarm to the holders of canal stocks, and a consequent depreciation of the shares has already occurred. One of the rival rail roads will traverse parallel with a great leading canal, and thus exhibit an excellent test of their comparative advantages.* Rail roads are almost

* A few of the new rail roads will be mentioned: the first from London to Edinburgh, the distance about 400 miles, by the rail road near 600; branches are to communicate with the several towns adjacent to the route. The proprietors are sanguine in their expectations that coal may be carried by land, from Newcastle to London, cheaper than by the colliers plying on the coast. The capital of this company is stated to be 2,500,000*l.* The second is from London to Liverpool by Birmingham, capital, 2,000,000*l.* The third is from Birmingham to Liverpool and Bristol; the capital, (1,500,000*l.*) was subscribed in Birmingham in six hours. The fourth is from Manchester to Liverpool, capital, 400,000*l.* distance nearly 35 miles. The expense required for these roads is much greater than for the roads previously described, and for these reasons; four sets of tracks are required; one for the going and one for the returning trade; and two for the carriages conveying the mail and passengers, at a far more rapid rate than is convenient on the other tracks. Locomotive, and stationary steam engines, near inclined planes, are also included in these estimates; and in some few cases even land for erecting warehouses for the use of the Company. The late extraordinary increase in the price of iron in Great Britain (amounting to 100 per cent. and occasioned by the great demand in consequence of the new rail roads, as stated in a letter to a respectable mercantile house in this city, dated, Birmingham, January 18, 1825,) explains the expensive estimates for these roads.

A rail road is constructing near Edinburgh, extending six miles with an inclined plane, and a stationary twenty horse power engine, with four locomotive engines of six horse power each, the expense will amount to 24,000*l.* deducting the engines, equivalent to 3,200*l.* or about 13,400 dollars per mile.

unknown beyond the limits of Great Britain; on the continent of Europe they are called *par eminence*, the British roads. In the city of Milan, however, I observed that a considerable number of the streets were provided with granite ways; the species of stone used for this purpose, is the hard and compact red granite of the Lago Maggiore, laid in masses of eight or ten feet in length, and one foot or eighteen inches in width and thickness. In the broad streets near the cathedral, four parallel roads are thus formed; the intervening space is paved in the usual manner.*

In the United States no extensive railways exist; on some of our bridges in Pennsylvania a rude railway or track for the wheels of carriages is provided; the uniformity of motion thus produced occasioning no concussion, ought to recommend their adoption in a more improved form on all similar wooden structures. Small railways of stone also exist in front of several of the houses containing fire engines in this city. A wooden rail track, which has proved very efficacious, is at present in operation under the direction of that excellent engineer, Mr. Randall, for the purpose of removing the excavated earth of the Delaware and Chesapeake Canal, below Philadelphia. A wooden railway for the purpose of transporting ice from the bank of the river, where the depôt was established, to the shipping in the Delaware, was introduced by our enterprising citizen, Turner Camac, Esq. whose early and repeated efforts in favour of internal improvement, entitle him to our gratitude. It is scarcely necessary to remark, that the launch of every large vessel,

* In consequence of this excellent arrangement, the inhabitants escape that most excruciating uproar, inflicted on us in such abundance in Philadelphia by the passage of every cart. The facility with which one horse can transport the weight usually drawn by ten, the absence in a great measure of dust and mud, the greater duration of carriages of all descriptions, from the little wear and tear to which they are subject on these stone railways, (which are adapted to every species of vehicle,) ought forcibly to recommend the adoption of them to our city Councils.

An improvement in economically effecting this object has actually been put in practice in Linlithgow and other towns in the same district in Scotland. It consists in placing stones of ten inches cube, in the usual direction of the wheel tracks. *The expense is only six shillings a yard, or 528l. per mile, for two courses composing one set.—See Stevenson's Essay on Rail Roads.*

On a hill where the difficulty of ascent was great, an iron railway for ordinary carts, was placed for the use of those ascending the hill; a weight can be drawn on this track up hill, with the same facility, as on the usual level stone pavement; this is a fact worthy of observation by the proprietors of hilly turnpikes; and of those towns where hills occur.—*See Picture of Glasgow.*

is an exhibition on a large scale, of the prodigious effects resulting from a species of railway, viz. the ship's ways.

Additional improvements in railways may be confidently anticipated; perhaps the recent discoveries of Sir Humphrey Davy, may succeed in preventing the oxidation of iron, in the same manner as he has already succeeded with other metals; in this event the great advantage that would result from polishing the surface of railways, is obvious. Another improvement may be effected with the cars. In Great Britain they are made of prodigious strength, frequently weighing half a ton, the load composing the remaining half! Wooden wheels may be substituted for those of heavy cast iron; smaller axles, and perhaps friction wheels, will considerably diminish the friction. A common cart weighing 700 weight, can easily transport three tons over a rough road, subjected to great and unequal strains and concussion; on a rail road the strain is always equal, and concussion never occurs: if therefore a common cart can transport a load seven times its weight, how much easier could a railway cart support perhaps even ten times its weight? This diminution of weight in these vehicles, will at once double the effect of rail roads. The heavy ring usually cast on the periphery of the wheels, may be dispensed with; and a small metallic *pointer* attached to the body of the car, which will occasion comparatively much less friction, will form an advantageous substitute. When water is deficient on the summit level of canals, rail roads are frequently used to facilitate the conveyance of a boat from one canal to the other, thus forming a substitute for locks. On rail roads, where a great difference of level occurs, inclined planes or perpendicular lifts, with suitable machinery are employed to elevate the cars to the higher level. In the majority of instances, steam-engines are used for this purpose; if the angle of ascent be slight, by detaching the cars, the horse can elevate one or more of them successively. Some remarks on the advantages of inclined planes for elevating weights, compared with locks on a canal, will be offered in another part of this essay.

Having now presented this historical sketch of rail roads, it is proposed to explain some of their properties. Although on a level a horse can transport eleven tons, four miles per hour;* or on a descent much more, if the angle be great; in

* A weight much greater than this is reported to have been transported by the same power, but not having ascertained the accuracy of the experi-

some cases, the weight can be transported, not only without the assistance of a horse, but even draw up a weight by the power thus acquired; (this is effected in many districts in Great Britain;) *but in ascending, no rail road, or other contrivance* can possibly enable a horse to elevate a greater weight *perpendicularly, than* 120 *pounds, at the rate of three miles an hour*, friction not being considered. By the agency of a pulley, (a machine with the minimum of friction) about 100 pounds has been raised at this rate; having before shown, that *a horse can draw on an improved and level edge rail road eleven tons, four miles per hour*, which is *equivalent to nearly fourteen tons, at three miles per hour;* therefore his horizontal draught is to his perpendicular draught, in efficiency, as 280 is to 1; viz. as fourteen tons to 100 pounds.

Any angle in the road will alter the power of draught in proportion to that angle; and as the mere friction, independent of the power of gravitation, is the same at all angles; by the above data, the resistance, in any given case, may be easily ascertained; always observing in practice, that *if the angle be considerable, a horse will be unable to raise any weight, and sometimes cannot even raise himself.*

By these data we ascertain, (what is confirmed in practice,) that if the elevation in a mile of rail road be equal to the two hundred and eightieth part of the length thereof, viz. nearly nineteen feet, it will require twice the power to elevate, (on an inclined plane of this length and elevation,) the weight drawn on a level, by a given power, with the same velocity; or, the same power may draw half the weight with the same velocity; or, the same weight, with half the velocity.

Hence on a road, with this angle uniformly ascending, it will require two horses to draw the fourteen tons, three miles per hour.

(On a good turnpike the force applied horizontally, is to the force employed in elevating perpendicularly as 20 to 1.)

Hills, whose angle of ascent is moderate, are not such serious obstacles in rail roads, as many erroneously suppose; this is apparent from this well known law of gravitation: *that bodies gain in descending, exactly the power expended in their elevation;* hence a load which on a level requires

ments, it is not deemed adviseable to insert them.—*See the Report of the Engineer on the Railway of the Earl of Glasgow, in the Edin. Supplement: also, Stevenson's Essay.*

two horses to transport it, will on an ascent of nine feet and a half per mile require three; but after arriving at the summit, *the descent to the same level can be accomplished by one only :* equal in the total distance to two constantly employed to draw the same weight the same distance, and with the same velocity. This, for very obvious reasons, does not obtain in practice; but the variation from the theory is extremely small in favourable circumstances on rail roads. In other roads, the advantage in descending, by no means compensates for the fatigue in ascending.* How far it may be adviseable to deviate from a straight line in rail roads to preserve a level, of course varies with several circumstances. On a level the same moving power is sufficient for the whole distance; where hills prevail, the changing of horses occasions delay and extra expense; the level railway will be longer, but it can accommodate thereby a greater extent of country; but it will be more expensive. If the commerce transacted be merely sufficient to yield interest on the capital required for the shorter route, that should be adopted. If the trade be sufficiently great to defray the extra expense of the longer level route, as some labour will be saved thereby, it should have the preference. (It has not been found expedient in England, to adopt the shortest possible route in their railways.) They have, however, this advantage over canals, that the distance is generally much shorter; whereas the length and local position of canals must, in some measure, be regulated by the summit level, and if the supply of water be drawn wholly from thence, or from any sole source of supply, one summit only can be adopted; on a railway they may be numerous.

Having now explained some of the properties of a railway; it is intended to compare them with roads and canals, in reference to the division made in the beginning of this essay: viz. 1. Expense, 2. Expedition, 3. Safety, and 4. Certainty.

The expense must vary in different countries, in proportion to the value of land, iron, stone and labour. In England, a rail road has been actually made over a bog for the small sum of 300 pounds sterling per mile. This is the cheapest on record.† The cost of a single stone railway in Linlithgow, was shown above to amount to 528*l.* per mile. The railway of the Earl of Glasgow as shown above, was 660*l.* per mile; these required no embankments or bridges. The rail roads now making in Great Britain, are estimated

* The cause of this variation is stated in a note to this essay.
† See Supplement to Edinburgh Encyclopædia.

at 4000*l.* per mile; and in *one or two* cases, from 9000, to 12,000*l.* per mile; expensive bridges and deep cuttings, &c. being included in these instances, in addition to many other expenses, stated in a previous note. We may safely state the *average price of a single railway* in Great Britain, (previously to the late alteration in the price of iron,) at 1000*l.* *per mile, exclusive of engines, deep cuttings, and bridges.* The extra expense in the U. States, will of course vary. In this country, commerce is not sufficiently active to require two sets of rails, and as places to turn out without delay or difficulty, may be situated every half mile or even at less distances, 2000*l.* would probably be an ample average allowance for a *single rail road* similarly situated. Whenever commerce shall be sufficiently active, a second or returning set of tracks, can be laid at a very small additional expense. The two other tracks used in England for the transportation of the mail and passengers at a velocity greatly exceeding six miles per hour, will not be required in this country for many years.

Here let us observe, that *rail roads may be made to accommodate any amount of commerce.* If the road should be completely occupied by cars, a circumstance almost impossible, a parallel set of tracks may be easily added; but the amount of commerce on a canal is limited by the supply of water, and the time necessary to pass the locks, (which, however, may be increased in number in some cases, thereby increasing the expense.) Rail roads can be made in every situation. The majority of them are at the present time subterraneous, viz. in mines. (Canals are frequently impracticable from a deficiency of water.) *Railways can be executed in a much shorter time, and at a less expense, than canals or turnpike roads; and are more easily preserved and repaired; and, should the course of trade change, they can easily be removed to a more favourable station; or the materials, always valuable, may be sold. When repairs are necessary, a substitute can be easily procured, and no delay, in consequence occurs, as on canals and turnpikes.* When locks are destroyed or injured, months may elapse before the damage can be repaired. Rail roads can be used all the year, if perfectly constructed; even snow offers no impediment. The drought in summer, and ice in winter are serious obstacles to the utility of canals; rain and frost are equally so on roads.

With locomotive engines in England the companies offer, on the completion of their rail roads, to convey goods at one-third

of the expense now charged on canals, and with three times the velocity. The expense of canal conveyance is known to be one to twenty, compared with the cost of transportation by the turnpike, (tolls not being taken into consideration.) By this improved method the proportion will be sixty to one, in favour of a rail road, compared with a good turnpike. To illustrate this. *If it be possible to carry this plan into execution in Pennsylvania, with the same advantages, a ton of goods can be transported at much less expense from Pittsburg, distant* 287 *miles*, (350 by the rail road probably,) *than from Germantown to Philadelphia, by the present turnpike, a distance of only eight miles!* Our market supplies are generally drawn from a circle of twenty miles diameter, or ten miles radius. *These supplies could be obtained at the same expense, from sixty times the distance, by the rail road and locomotive engine*, viz. from a circle of 600 miles radius, or 1200 hundred miles diameter. (The area or contents of a circle of 20 miles, is to the area of a circle of 1200 diameter, as 1 to 3,600,) *i.e. the country whence our supplies could be drawn, would be* 3,600 *times more extensive than it is at present!* This may appear rather startling and visionary to some persons, *but if the above data be correct*, this deduction is unquestionably legitimate.

Monopoly will be prohibited, by this system of rail roads opening a large district, wherein the competition of agriculturists will materially lessen the expense of produce. *A horse, and a boy to direct him, can transport on a railway of the best form*, (as shown above,) *about fourteen tons, at the rate of three miles per hour. One boy can attend to many horses and cars, if necessary; whereas on a canal, one horse, a boy, and a man, are absolutely necessary to every boat*, and sometimes another bargeman is requisite. It is found to be most economical in practice on canals, to transport no more than fifteen or twenty-five tons in one boat, although its capacity and that of the canal, can receive a larger quantity. On a turnpike, to carry fourteen tons requires twenty-eight horses and six wagons; moving at the rate of only two miles per hour. On a rail road, the expense of a man being saved, an additional horse may be attached to the cars, with this expense. The united efforts of the two horses can transport twenty-eight tons three miles per hour, a weight greater than it is deemed expedient to transport on canals. With locomotive engines, (as I have stated above,) even more (viz. eighty-four tons,) may be transported at the same expense in Great Britain, which is there required for the trans-

portation of twenty-five tons on canals. But as the tolls charged on canals are high in that country, we cannot expect to realize this great comparative advantage. *The proportion between canal, and rail road conveyance will* (if it is in England three to one,) *probably* be in the United States as one and a half or two to one.* The reasons are obvious.

* In England, the companies recently established offer to convey merchandize on railways, by the assistance of locomotive engines, at one-third the expense now charged on canals. *If the tolls on canals be considered,* the above proportion of sixty to one will not prevail in favour of rail roads compared with the best turnpikes. Some obscurity prevails in the Prospectus of the projectors on this subject. If, however, horse power be used on railways, one boy can superintend seven horses, (a power nearly sufficient to transport 100 tons at the rate of three miles per hour,) and the labour of three men and four boys being saved, (four horses, four men, and four boys being required to transport this quantity on a canal, or 100 horses and 20 men on the best turnpike,) the total expenditure in this country will be probably from 97 *to* 98 *per cent less on a railway than by the turnpike roads,* as they are constructed at present in the United States;* transportation by *canals being* 95 *per cent. cheaper:* viz. a ton of merchandize will cost 100 dollars, if conveyed a given distance; *it may be conveyed the same distance by a canal for five dollars, and by a railway for two dollars.* and fifty cents

Expense of transporting 100 *tons, the distance* 100 *miles.*

Two-thirds of a ton, the wagon inclusive, is usually the load for each horse, when constantly employed, on an American turnpike.

150 horses, at 75 cents per day per horse, is	$112.50
30 men, at 75 cents per day per man, is	22.50
Expense per day is	135.00
It will require 6 days,	6
The expense on a turnpike is, therefore,	$810.00

Expense by a railway for 100 tons 100 miles, (when horses are employed as the moving power.)

7 horses, at 75 cents per day per horse, is	$5.25
1 man, at 75 cents per day, is	75
	6.00
It will require 4 days only,	4
	$24.00

A paragraph in the Morning Chronicle mentions some experiments performed with a locomotive engine, near Newcastle, (not mentioning whether the engine was of the improved species or not.) The engine was eight horse power, and consumed five pecks of coals every hour, or ten bushels for eight hours. It drew, in addition to its own weight, 32 tons three miles and three quarters per hour, (about one-third only of the

* Fourteen hundred weight is considered a full load for a horse on the turnpike, the weight of the wagon inclusive: or half a ton exclusive.

† 1st. By a canal, five boats of 20 tons each, five horses at 75 cents each, five men at 75 cents each, and five boys at 50 cents, is 10 dollars per day. It will require five days; viz. 50 *dollars per* 100 *tons of merchandize for* 100 *miles;* or if four boats be sufficient, the expense will be 40 dollars for do. do (the weight of the boats exclusive.)

‡ 2d. If the weight of the wagons be deducted, the expense of transporting 100 tons of *merchandize* will be 1215 dollars for 100 miles; *i. e. the expense of turnpike conveyance of* 100 *tons for* 100 *miles, is to the expense of conveyance by the locomotive steam-engine, on a railway,* (coal being 15 cents per bushel,) *as* 1215 *dollars is to* 20 *dollars, or as* 60 1-4 *is to* 1; (tolls on the turnpike, or railway, not taken into consideration:) but as the quantum of commerce will

The *expense of carriage* on an inclined plane, when a rail road is used, compared with canals, depends on the inclination. On a level, it has been shown, that the canal is more expensive: and on a descent, the rail road requiring no locks, is far less expensive to construct, and a much greater weight can be transported by a given power. In ascending, locks are of course required on canals, the expense of constructing which, *in a durable and correct manner*, is from 600 to 1400 dollars per foot, equal to an average of 1000 dollars per foot. *If a railway, in the form of an inclined plane, or lift, be employed, one horse can elevate twenty-one tons nine feet and a half in fifteen minutes;* or two horses, (those employed in dragging the cars for instance,) can elevate the same in seven minutes and a half. Hence their advantage in economy and expedition.* Where *rapid conveyance* is required, in consequence of a law of motion stated in the following paragraph, railways offer the only medium for transportation that can rationally be adopted; where the motion required is slow, viz. not exceeding two miles per hour, canals, or water conveyance are preferable, when the expense of construction is equal, or not greatly exceeding that required for a rail road. In a rapid descent, however, railways are preferable in any circumstances. †

2d. Expedition. On canals, a given weight can be transported by one horse, with a certain velocity; *the addition of*

weight usually drawn by eight horses, *on an improved edge railway.*) If an engine of this description were in Pennsylvania, the expense of transporting the [illegible] tons, 100 miles, would be (coal being estimated at an average price of [illegible] cents per bushel) one dollar fifty cents for thirty miles. Two engineers being alternately employed twelve hours, at 75 cents each, is 1 dollar 50 cents, or 6 *dollars 50 cents the total expense*, and the time about 26 1-2 hours. *The expense, and wear and tear, of an eight horse power steam-engine, is less than the expense, (including wear and tear,) of 24 horses, to which the power of the engine, perpetually in operation, is equal.*

There is some reason to believe that the weight of the cars is not included in the 32 tons above mentioned; if this be the case, the effect of the engine is far more advantageous than this estimate exhibits. (The weight of this engine was 5 tons, and the weight drawn in addition to the cars and engine was 32 tons 18 cwt.)

* The time required to pass a lock is (including the loss of momentum) one minute per foot. Sometimes forty seconds.

† Canals leading to coal and other mines are generally, for the above reasons, more advantageous; hence the canal companies in this state need be under no alarm. Few persons are aware how small a force is requisite to communicate a slow motion to bodies of great magnitude. A large ship of 600 tons, at our wharves, can be slowly moved by the force of a child, (if the water be smooth). A raft of nearly a mile in length has been drawn, (on the Middlesex canal, near Boston,) at the rate of one mile per hour, by one yoke of oxen.

another horse will not double the velocity; for the resistance to bodies moving in fluids is (according to the well known law,) *as the square of their velocity.* Hence if a weight drawn by a horse at the rate of one mile per hour, be required to move with a velocity of two miles per hour, *two horses will be unable to effect it;* it will require the exertions of *four.* If treble the velocity, viz. three miles, it will require nine : if four miles, it will require sixteen : *if ten miles, it will require one hundred horses!!!* thus increasing in a very rapid ratio. The swell, or undulations in the water, increase in the same proportion ; and the last mentioned velocity, viz. ten miles, would cause an agitation that would, in a very short period, destroy a canal. Hence boats are usually prohibited a velocity exceeding three or four miles an hour on canals. *On a railway on the contrary, equal increments of power, produce equal increments, or increase, of velocity,* which is always in proportion to the friction. IN THIS CONSISTS THE GREAT ADVANTAGE OF RAIL ROADS COMPARED WITH CANALS. It is contemplated in Great Britain to convey the mail and passengers at the rate of fifteen miles per hour. Hence their utility in war.

Great delay occurs on canals, particularly where locks are numerous, when an ascending and a descending boat arrive at the same time, at a lock, or series of locks. One of them must wait during the time occupied by the other in passing, or a double set of locks, (and of course a double expenditure,) must offer the alternative.

3d. Safety. All articles may be transported on railways without risk of damage by breaking ; the uniformity of motion resembling that of water conveyance. There is no risk from damage by water,—no small advantage over canals in an exposed situation.

The health of a country is promoted by the adoption of railways, as no poisonous miasmata, generating disease, which invariably arise from stagnant water, will be produced ; dust is almost unknown on rail roads ; hence the comfort of travellers, and those residing on the road side, will be augmented.

4th. Certainty : as the rail road is not affected by the vicissitudes of the weather, and is easily and expeditiously repaired if injured by accident. (Canals, when injured by design or accident, may require many months to repair—a single lock lately at Albany required one or two months, detaining all the vessels employed.) Hence this object is also attained.

Having now shown that railways are preferable in *economy* and perfect *practicability* of construction, and *cost of conveyance*, in *expedition*, *safety*, and *certainty*, may we not confidently anticipate the period, when canals will no longer be *generally* used ; and that rail roads will be known as the only rational medium of conveyance ? when we shall behold them meandering through every district where man has fixed his habitation ? when the inhabitants of Mexico and Hudson's Bay,—of Astoria on the Pacific Ocean, and Philadelphia on the Atlantic,—shall, by this invention, be converted into neighbours ; and the blessings of commercial intercourse be universally diffused ; binding together our species in peace and friendship, by the indissoluble bond of community of interest ?

Fig. 1.

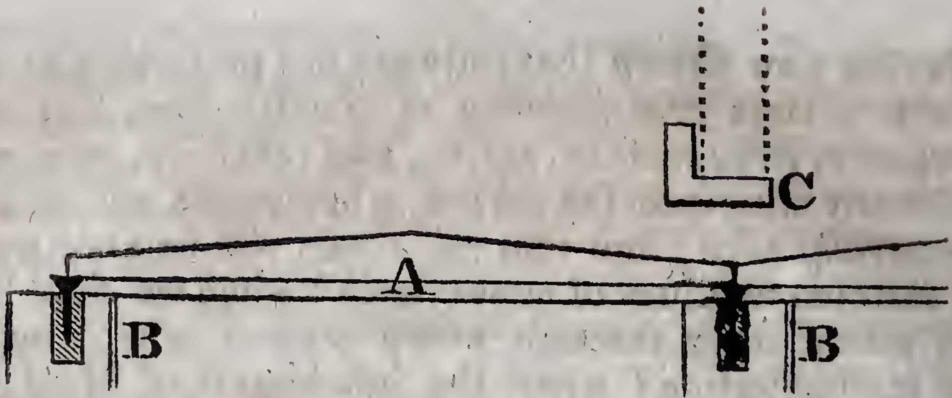


Fig. 2.

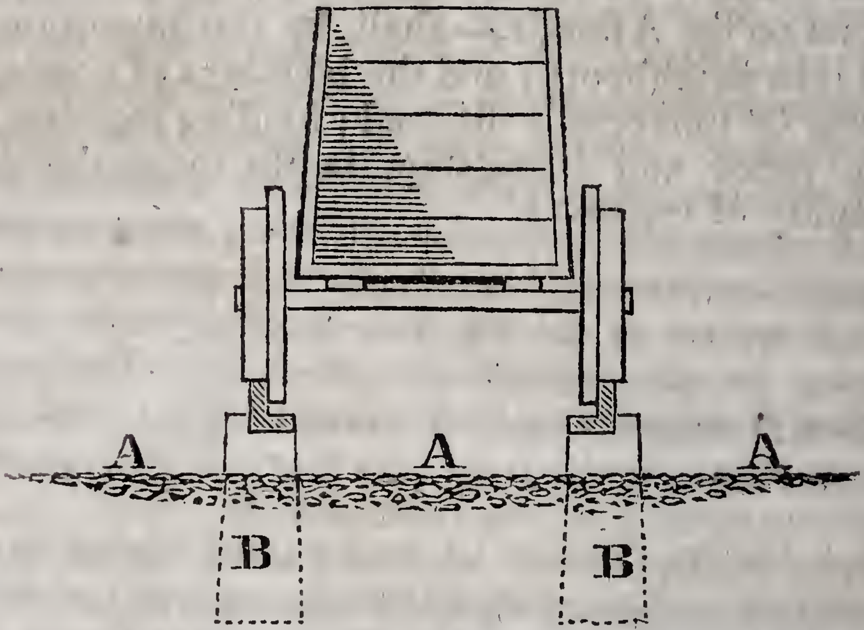


Fig. 3.

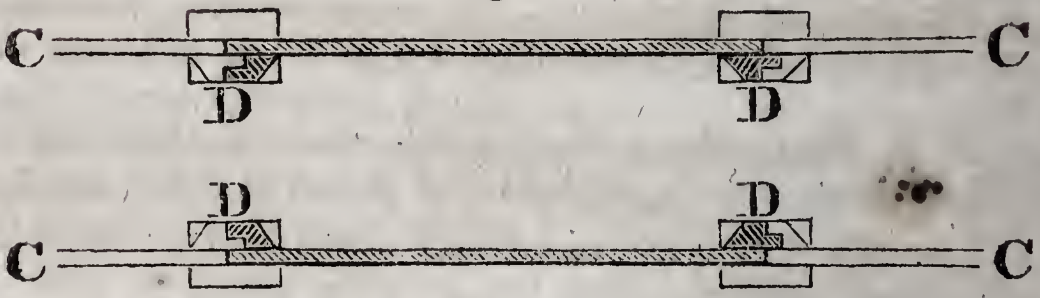
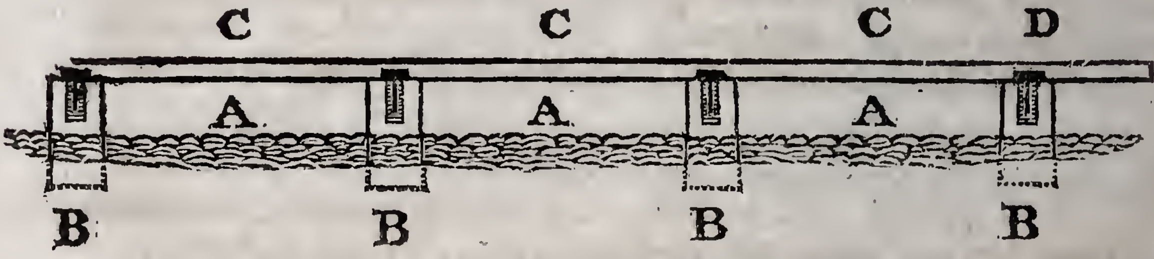


Fig. 4.



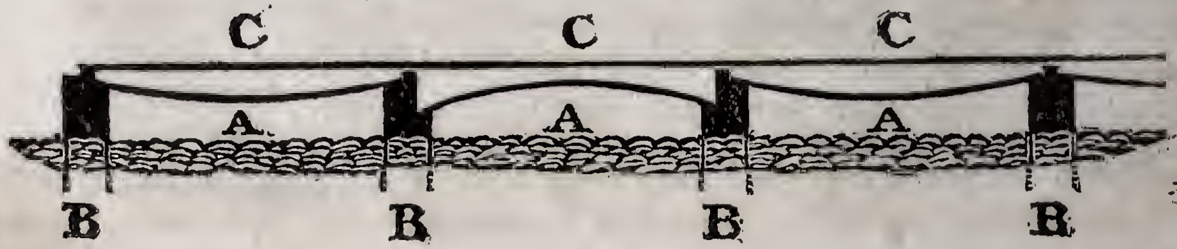


Fig. 5.

EXPLANATION OF THE PLATES.

Fig. 1.

A. is the profile of a *flat* railway, with the flange; the perpendicular portion of a triangular shape, at right angles with the horizontal surface A. on which the wheels revolve. This form is given to the flange for the purpose of strength.

BB. stone piers or props, showing the wooden plug and nail driven therein, to secure the rail in the proper position.

C. a section of the flat rail, the dots representing wheels moving on the horizontal surface C. The perpendicular portion is the section of the flange.

Fig. 2.

Is a section of a car or wagon; and a section of the edge railway for which it is designed.

AAA. the surface of the earth. The central portion, A. is the path for the horses. It is sometimes raised above, or sunk below, the surface of the ground adjoining the railway.

N.B. By omitting the interior wheels, (the flanges,) and substituting a spike, attached to the axle of the car,—which can come in contact in a *single point only*,—much friction will be prevented.

Fig. 3.

Is a plan, or bird's eye view, of the edge railway.

CCCC. the edge rail.

DDDD. joints resting on the stone props.

Fig. 4.

Is a profile and section of an edge railway, in which common bars of iron are used without any alteration.

BBBB. the stone piers.

CCC. is the bar.

D. is the joint, wooden plug, and nail.

Fig. 5.

Is a profile of the improved railway. The reversed arch, or springing arch, as at AAA. renders the iron bar *stronger*

than the same quantity used in *fig.* 4. in the form of a bar of uniform thickness. The arches are all reversed, or all similar to the centre; but to comprise them in one plate, they are represented as differing in the same railway.

BBBB. stone or wooden props to support the bars. They must be sunk to a depth sufficient to protect them from the action of the frost.

They may be elevated to the height of two or three feet above the surface of the soil, to protect the rail from the snow. It will also improve the line of draught.

In this rail, the upper portion, CCC. on which the wheels glide, being one inch and a half in thickness, the under portion, AAA. is reduced to three-fourths of an inch. The strength of this form permits this with perfect safety; thus exhibiting the maximum of strength, with the minimum of material.

It has not been deemed necessary to exhibit an engraving of the convex or of the concave rails; in these no flanges are required. The wheels of the cars are constructed with convex or concave rims, which, accurately corresponding to the curves cast on the rails, prevent the cars from deviating.

APPENDIX.

To connect the eastern and western divisions of our country by some magnificent monument of public enterprise, is at the present moment in serious agitation. Nearly half a century has rolled away, since the plan for connecting the great valleys of the Mississippi and St. Lawrence, with the valleys of the Susquehanna and Delaware, was first devised by the gigantic intellect of those statesmen, to the wisdom of whose measures we are indebted for the benefits we are at the present moment so abundantly enjoying. About five and thirty years have elapsed since *the first canal from the Atlantic ocean to Lake Erie, was commenced in Pennsylvania.**

The two first sections are now, after surmounting innumerable obstacles, nearly completed. The two remaining divisions are yet to be accomplished. To continue the work now depends on the wisdom of an enlightened people. Meetings have been held in various districts of this commonwealth, to contribute to the accomplishment of this magnificent undertaking; and the voice of approbation from the people has rung through the valleys and plains of Pennsylvania, from Philadelphia to Pittsburg, and from York to Tioga. This was to have been expected from a State whose enterprising citizens, at a far distant period, led the way in the grand system of internal improvements; and accomplished works of gigantic magnitude, long ere the attention of any of her sister States was attracted to the subject.

* The Susquehanna and Schuylkill, and Schuylkill and Delaware Canals, the two first links in this great chain, were for some time prosecuted with vigour, and 500,000 dollars expended. These works, with the Delaware and Chesapeake Canal, unfortunately were suspended, but are now *nearly* completed, at an expense of about 4,000,000 of dollars.

A State which, at the present period, offers to the eye of the traveller the noblest turnpikes in America, and bridges unrivalled in magnitude and scientific boldness of design; and which is modestly pursuing the noiseless, even tenor of her way, has expended, in conjunction with her citizens, upwards of TWENTY-FIVE MILLIONS OF DOLLARS* for internal improvements, independently of the vast sums devoted to similar objects in the counties: *an amount unequalled by any State in the union, however ostentatious.* But no single work, to concentrate the attention, and to diffuse its blessings impartially to all her citizens, similar to the Western Canal of New York, presents itself in Pennsylvania. Nearly all our works are local, and consequently partial in their operation. The period has now arrived to remove this reproach. *Pennsylvania may execute the first grand railway in the New World. The people have determined that a great public communication shall be effected between the East and the West.* They have willed it, and it must be executed. The period has passed away when prejudice, ignorance, and interest opposed its progress. The mound has been prostrated, and the deluge of information, boundless in quantity, and irresistible in force, is fast sweeping away the last vestiges of opposition. The Pennsylvania Society for the promotion of internal improvement has powerfully contributed to this beneficial alteration in the public opinion.† Let us therefore seize on the present moment. The works already constructed by our ancestors for our benefit, demand the payment of our debt of gratitude, in the only manner in our power,—to our posterity. The works we ourselves have achieved demand the continuance of our efforts, without relaxation, to preserve the reputation so laboriously acquired. Surveys, by *scientific, practical, and disinterested engineers*, should be *immediately* commenced; all the information on this subject in Europe should be procured, digested, and cautiously examined. If, on mature deliberation, a canal or railway be recommended,‡

* Documents in the possession of the writer of this sketch confirm this statement beyond the possibility of doubt.—See also Journal of the Senate of Pennsylvania for 1821; also State Laws. Does this countenance the obloquy and slander, incessantly repeated, that Pennsylvania is dead to enterprise?

† The State is under great obligations to the American Philosophical Society, also, whose essays and surveys, effected with great expense, contributed to produce this spirit for internal improvement, of which Pennsylvania exhibits so many monuments.

‡ Two routes for a canal have been surveyed; the northern and southern. These surveys *may* probably be serviceable in determining the route for a

all the zeal, patriotism, and intelligence of the State will be called into action, to bestow the most cordial co-operation for its accomplishment. The endeavour to impress on the minds of our citizens the benefits resulting from this great work, is indeed unnecessary. Our commonwealth has been blessed by Providence with a fertile soil, a healthy climate, and with mineral riches, exceeding those of any other State, and far more valuable than those of Potosi and Golconda: and shall we contribute nothing? If here every gift has been so bountifully bestowed, will her citizens themselves do nothing? Have all these blessings been conferred on a population ignorant of their value, or too indolent to avail themselves of the advantages offered to their acceptance?

To facilitate the interchange of commodities, and by extending commerce to destroy monopoly,* to render the most

railway. No tunnel will be required, if a railway be adopted. If a tunnel be expedient, as the dimensions may be one-third of those required on a canal, one-third the expense will be sufficient: or the tunnel may be three times the length with the same expense. An inclined plane over the Alleghany, with extra horses, steam-engines, or water power, will be found more economical. The present bridges over the Susquehanna are sufficient for the support of railways. Canals require expensive aqueducts.

As no correct surveys, made in reference to a railway between Pittsburg and Philadelphia, exist, any calculation of the expense, pretending to accuracy, must be at once presumptuous, vague and unsatisfactory.

From the data already in possession, we are probably authorized, (without incurring the dangers aforesaid,) to assume for the *estimate of constructing a single edge rail road, of three hundred miles in extent, to connect these cities, the liberal sum of* 3,000,000 *dollars. A sum so trifling, so far, and so completely within the power of the Commonwealth of Pennsylvania,* (the most wealthy in the Union,) that any attempt to point out ways and means to raise this trifle, might seem a premeditated insult to the majesty of a State, whose unbroken faith, from her settlement to the present hour, enables her to raise, at a moment's warning, any sums, however large, which, those who guide her destinies, may think requisite for her accommodation.

* The entering wedge to destroy monopoly was put in operation in the year 1794, when the Philadelphia and Lancaster turnpike (*the first executed on this side of the Atlantic*) was executed. It met with great opposition from those interested in preserving a monopoly; but vigorous and judicious efforts silenced the clamours of those who attempted to defeat a plan, the benefits of which are now so apparent. The same interested opposition, founded on selfish and false principles of political economy, influenced the opponents of the first turnpike, constructed about 70 years since near London. Canals and railways have hitherto, so far from proving detrimental to the interests of road proprietors, by creating more commerce, actually benefited the works they seemed calculated to supersede. Farmers, from the unlimited demand for produce in an exporting commercial port, need not be under apprehensions, that the value of their land will decrease, from the increase in the quantity of produce which canals and rail roads occasion.

The village of Astoria, on the Columbia or Oregon river, near the Pa-

distant inhabitants of the West the immediate neighbours of those residing in the East, and by frequent intercourse to remove prejudices, resulting entirely from the present obstacles to an acquaintance, and free interchange of sentiments; to promote our defence in war, and to diffuse the blessings of "peace and plenty round a smiling land," have too long and too frequently been objects of contemplation to the reflecting citizens of this commonwealth, to suppose that any other course than that at present contemplated can ever be adopted, when, if successfully executed, it would diffuse throughout the State, the advantages which wealth confers in the increase of physical comforts, in the advancement of literature, science, and the arts, (the constant attendants on national prosperity, in America,) and in the creation of new sources of industry, in promoting morality, by furnishing employment to all her citizens, and thereby removing the temptations of indigence, are *objects so transcendantly important, so ardently desired, and so perfectly attainable*, that it is a libel on our legislature to suppose them capable of hesitation, or deficiency of resolution, when the delay of every hour is detrimental to our welfare.

THE PEOPLE COMMAND, AND THEY MUST BE OBEYED.

cific Ocean, distant between 3 and 4000 miles from Philadelphia, will, when at some distant period a railway may be constructed, be, considered in a commercial view, at no further distance from us than the city of Lancaster is at present by the turnpike, the *expense* of carriage being sixty to one. In point of time, of course more delay will be experienced, unless the rapid locomotive engine be adopted, at the rate of fifteen miles an hour, (the estimated velocity in England.) Astoria may be visited from Philadelphia in 240 hours; viz. in ten days!!! From the rapidity with which merchandize is conveyed in Great Britain (four to eight miles per hour on the railway,) vast benefit must be derived by that commercial and populous country. The same rapidity, although desirable, cannot prove equally beneficial in the United States. Hence the locomotive engine may not be employed with the same advantage here. In Great Britain, the expense of maintaining horses, and the tax on them compared with the cheapness of machinery, and abundance of coal, recommend the employment of steam-engines, where it would not be expedient in America. In the abundance of coal, Pennsylvania is not exceeded by any country on the face of the globe.

Philadelphia, March 15, 1825.